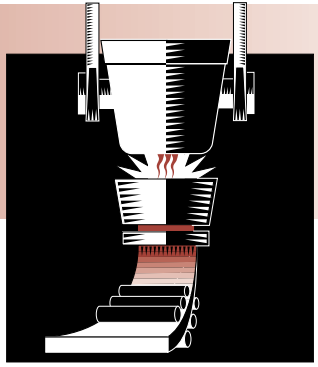
STEEL

Project Fact Sheet



Optical Sensors and Controls for Improved Basic Oxygen Furnace (BOF) Operations

Benefits

- Improved industrial competitiveness through product optimization
- Reduced energy usage via real-time temperature measurement and process end-point control
- Reduced maintenance on BOF refractory via automated furnace inspection
- Environmental improvements via process optimization including: reduced oxygen usage, minimized BOF dust production, and real-time combustion zone monitoring

Applications

Implementation of a suite of new robust sensors in BOF steelmaking operations makes possible dynamic process control, as well as rapid assessment of the effectiveness of operations such as post-combustion and slag-splashing. Commercialization of these sensors will permit optimization of oxygen-lance position, oxygen flow-rate, carbon end-point, and melt temperature. Rapid three-demensional (3-D) contouring of furnace surfaces, ladles, and coke ovens will allow accurate wear estimates on a heat-to-heat basis.

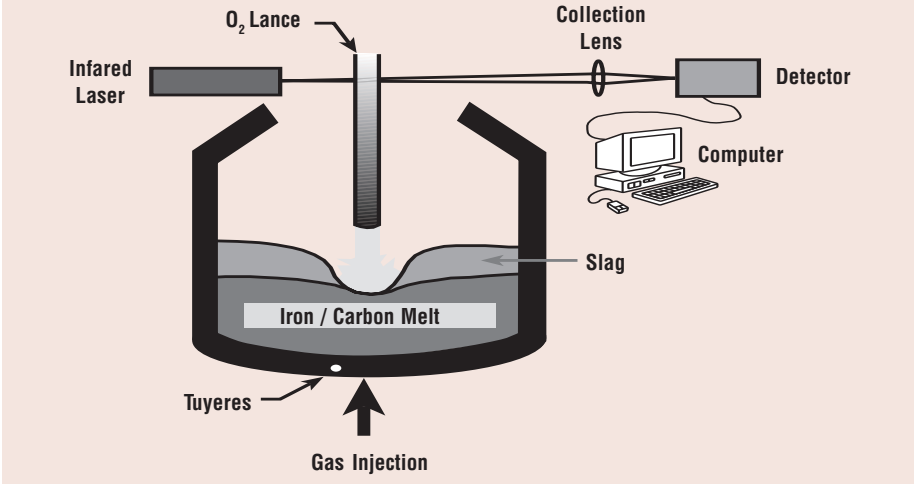
OPTICAL SENSORS PROVIDE THE BASIS FOR REAL-TIME PROCESS-CONTROL STRATEGIES TO REDUCE COSTS, IMPROVE PRODUCT QUALITY AND EFFICIENCY, AND MONITOR REFRACTORY WEAR AND SLAG-SPLASHING EFFECTIVENESS IN BOF STEELMAKING

One project objective is to develop and commercialize laser-based sensors to measure the temperature and composition of off-gases. These sensors will provide an early and direct indicator of when the steelmaking process is complete. The process uses an infrared laser beam fired across the mouth of the vessel to a spectrometer that detects molecular interference with the beam. The instantaneous analysis of carbon monoxide, carbon dioxide, and water in the gases indicates the carbon level of the bath with a high degree of accuracy.

Another task involves developing an optical sensor mounted in the tip of the oxygen lance, which measures the temperature of the hot spot zone where oxygen ignites as it contacts the steel. Since the hot zone temperature drops off rapidly when all the carbon is burned off, it also provides a rapid indication of when the heat is done. When the surface of the steel bath is exposed, the bulk bath temperature can be directly measured.

A third activity involves the development of automated range-finding techniques for measurement of BOF refractory wear, lance position, and the BOF levels of metal or slag. This family of new sensors will permit new strategies for continuous dynamic process control of steelmaking processes.

Laser-based Sensor



An infrared laser beam is fired across the mouth of the vessel to a spectrometer that detects molecular interference with the beam.

Project Description

Goal: New advanced sensors make dynamic control of steelmaking processes possible.

The objectives of Optical Sensors for Gas-Phase Composition and Temperature are to:

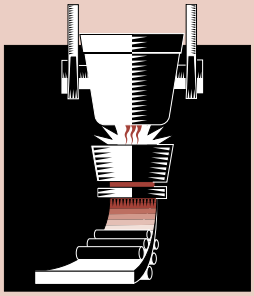
1. Optimize basic oxygen furnace operation through dynamic process control.
2. Provide real-time diagnostic tools for post-combustion and melt decarburization.
3. Provide real-time measurement of dust loading in the off-gas.
4. Minimize excess thermal loading of BOF vessel refractory by monitoring off-gas temperature.

The objectives of Optical Sensors for Bath Temperature Measurement and Range Finding are to:

1. Determine bulk temperature from slag temperature using optical image-based techniques.
2. Monitor the hot spot emission during oxygen blowing to aid in endpoint control.
3. Provide real-time video imaging of the furnace interior (refractory life).
4. Measure the bath height for improved control of lance operating practices during the oxygen blowing process.
5. Permit rapid 3-D measurement of the contour of interior furnace refractory to assess wear and effectiveness of slag-splashing and tuyere operation.

Progress and Milestones

- Project start date, April 1993.
- A full-scale demonstration of BOF gas composition and bath temperature sensors has been successfully completed.
- The range finder has been demonstrated successfully on a pilot scale steel vessel and was commercialized in 1999.
- The successful integration of the optical sensor suite into an oxygen lance system has been accomplished, and a new instrumented lance is commercially available.
- Project completion date, December 2000.



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